Statistics

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Aims of the course

This course provides PhD students with an in-depth understanding of statistical methods, focusing on their application in economic and business research. The course emphasizes the role of the scientific method in research, data analysis, and model testing.

Students will gain the knowledge to critically analyze data using inferential statistical techniques.

The use of the software R is mandatory for data analysis throughout the course.

Learning outcomes and competences

By the end of the course, students will be able to:

• Apply the scientific method to experimental design and data analysis in economics and business.

• Distinguish between inductive and deductive reasoning in research.

• Develop and test scientific hypotheses using appropriate statistical models.

• Apply inferential statistics to make general conclusions about populations based on sample data.

• Understand and apply different probability distributions (normal, chi-squared, tdistribution, etc.).

• Perform hypothesis testing, including parametric and non-parametric methods.

• Use the R software for statistical analysis.

Pre-requisites

Students should have a basic understanding of statistics and probability, as well as experience with statistical software, particularly R. Prior coursework in statistics at the undergraduate or master's level is recommended.

Course contents and syllabus

1. Introduction to the Scientific Method
• Importance in experimental design and data analysis.
• Inductive vs. deductive reasoning.
• Observational studies and hypothesis testing.

2. Probability and Random Variables
• Definitions and examples of discrete and continuous random variables.
• Probability distributions: Normal, chi-squared, t-distribution, Fisher's F-distribution.
• Expected value and variance of random variables.

3. Inferential Statistics
• Sampling methods and the importance of random sampling.
• Estimation techniques: Point estimates and confidence intervals.
• Central limit theorem and its applications.

4. Hypothesis Testing (part 1)
• Null and alternative hypotheses.
• Types of errors: Type I and Type II errors.
• Statistical significance and p-values.
• Parametric tests: t-tests, ANOVA.
• Non-parametric tests: Mann-Whitney-Wilcoxon, Wilcoxon signed-rank test.

5. Hypothesis Testing (part 2)
• Multiple testing and Bonferroni correction.
• Robust statistical methods.
• Non-parametric tests for skewed distributions.
• Comparing parametric and non-parametric methods.

Organization of the course

Students are expected to read the literature and research papers provided to them. The course will also make extensive use of the statistical software R for hands-on analysis.

Assessment method

• Assignments: Problem sets involving real-life data analysis using R (30%).
• Test: A single-choice test (50%).
• Participation: Active participation in class discussions and practical sessions (20%).

Grades will be based on the quality of assignments, the final project, and class participation. A passing grade requires a minimum of 60% overall.

Reading list

None